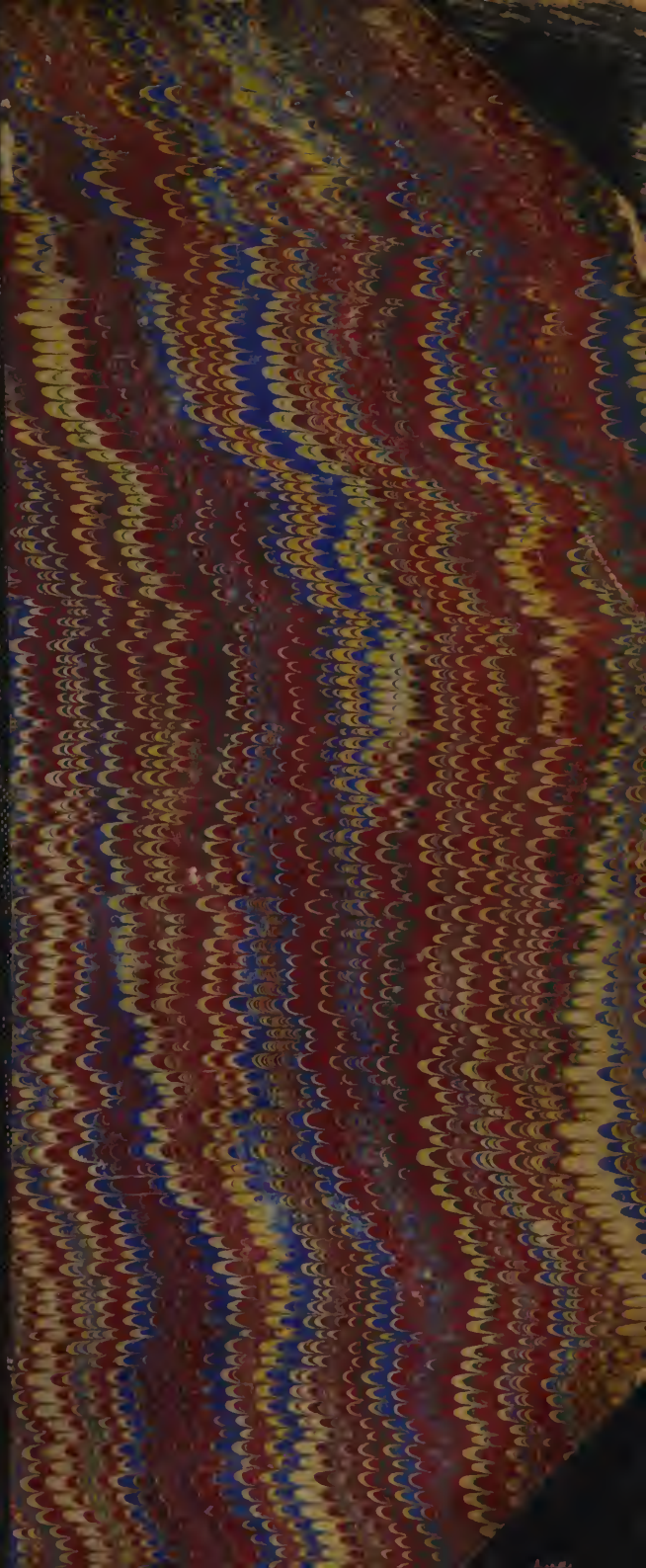


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# GENERAL REMARKS

ON

# DIURETIC REMEDIES,

DELIVERED AT THE

University of Maryland,

FEBRUARY 16, 1860,

By CHARLES FRICK, M. D.,

PROFESSOR OF MATERIA MEDICA AND THERAPEUTICS.

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PUBLISHED BY THE CLASS.

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1895/10/10

BALTIMORE: . . . PRINTED BY JOHN W. WOODS,

No. 202 BALTIMORE STREET.

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1860

UNIVERSITY OF MARYLAND,

*February 20th, 1860.*

PROF. CHARLES FRICK :

*Dear Sir,*—The “Medical Class” of the University of Maryland, appreciating your interesting and instructive Lecture on “Diuretics,” delivered on Thursday last, have imposed upon us the pleasing task of requesting of you the manuscript for publication.

By complying with the above request you will confer a lasting favor upon the class.

We are, most Respectfully,

Your Obedient Servants,

J. J. BECKENBAUGH,	} <i>Committee.</i>
A. L. MIDDLETON,	
J. EDWIN MATTHEWS,	
H. L. SPICER,	
J. W. HEBB.	

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BALTIMORE, *February 20th, 1860.*

GENTLEMEN :

In reply to your note of this date, I have to say, that my Lecture is entirely at your service.

I feel exceedingly gratified at your request, not only from the personal compliment it conveys, but also as an evidence of your approbation of the course of instruction I have pursued this winter.

Very truly, Yours, &c.,

CHARLES FRICK.

To

MR. J. J. BECKENBAUGH,	} <i>Committee.</i>
“ A. L. MIDDLETON,	
“ J. EDWIN MATTHEWS,	
“ H. L. SPICER,	
“ J. W. HEBB.	





## DIURETICS.

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I PROPOSE to-day, gentlemen, to speak to you of a class of medicines, a proper understanding of which, at the present time is one of the most important points bearing upon the relation of Therapeutics to Pathology. I mean Diuretics, or those remedies which promote the secretion of urine. And I approach the subject with some diffidence, partly because its correct appreciation is a matter of the extremest importance to your knowledge of medicine, inasmuch as with few exceptions, it has not at all received the consideration it demands; and partly because the facts in reference to it are stated so loosely, are oftentimes the result of such badly conducted experimentation, and are so often the conclusions arrived at by false and vicious theorizing, that they are too apt to be utterly valueless. In the present lecture I shall endeavor to set before you, to the best of my ability, the true relation that this class of remedies bears to disease, how you are to estimate their value, and what conditions of the kidneys modify or favor their employment.

In all works on therapeutics, diuretics are defined to be medicines which promote the secretion of urine. This definition is correct, but unfortunately, to many minds an increased secretion of urine implies merely an increased amount of urine; that is, the urine which formerly amounted to but a pint in the 24 hours, has become increased during the administration of certain remedies, to a quart. Now this may be in reality an increase, that is, the addi-

tional pint may bear with it an increased amount of solid matter. But it does not follow that such will be the case. The extra quantity may consist of water merely ; and this water be occasioned simply by an additional amount of fluid taken into the stomach ; or because the skin is exhaling a less quantity of its peculiar secretion than previously, In either case, the absolute loss or drainage from the body is not increased, and the diuretic effect is more apparent than real.

But I think I can explain this more satisfactorily by occupying your time for a brief period with some general remarks in reference to the physiology of the kidneys. You will be told, elsewhere, that life consists of constant change, that from the commencement of infancy to the extremes of old age, there is the constant addition of new material to the body, and the subtraction and elimination of that which is worn out, and which has fulfilled its purpose in the animal economy. You will learn that these changes vary under innumerable circumstances, but that no muscular movement, or thought, or action, takes place that is not accompanied with some alteration in the particular organ or structure brought into activity. That through the lungs, the oxygen of the air is brought into contact with the blood, which in turn, circulating throughout the whole body, effects certain changes ; reparative on the one hand, and on the other, absorbing into itself those elements which are destined for elimination. These it presents to the proper organs,—the carbon in the form of carbonic acid to the lungs, the bile to the liver, certain other excretory elements to the skin, and the urine to the kidneys.

The kidneys then are eliminating organs. Let us look a little more clearly into their peculiar function. The urine we find consists of three separate elements ; in the first place, inorganic substances ; secondly, organic substances ; and thirdly, water. The first, the inorganic, are derived partly from the metamorphosis or disintegration of tissues,

and partly from the food ; so also with the organic elements, as the urea uric acid, &c.; while the amount of water in which these are dissolved, is due simply to the quantity of fluid presented to the kidneys by the blood. And inasmuch as one of the important offices these organs fulfill is to preserve the amount of fluid in the blood in proper proportion to the wants of the economy, and at the same time to be a counterbalance to the perspiratory function ; it will be found that the amount contained in the urinary secretion will be greatly influenced by the quantity of water taken into the system, and by the condition of the cutaneous exhalation. In other words, the quantity of urine passed is no test, by itself, of the increased or diminished function of the kidneys.

The result of numerous and accurate experiments demonstrates that a healthy individual passes from these organs from 6 to 800 grains of solid material in the 24 hours, it may be, for all practical purposes, assumed to be 700 grains. Now this material represents two separate things. First, the elements of the worn out tissues ; and secondly, those substances which although absorbed by the blood, subserve none of the purposes of nutrition, and therefore seek an outlet by the kidneys. And the 700 grains, which is the daily and healthy average of this material, may be dissolved either in one pint or two quarts of water. In the latter case the amount of urine will be four times as large as in the other. But inasmuch as the water is dependent in great measure upon the action of the skin and the amount of fluid taken as drink, and the solid materials are the representative of the manner in which the chief function of the kidneys is performed, it follows that in both the instances I have supposed, although in the one case the quantity of urine quadruples the other, the organs are performing their duty in exactly the same manner. How then, you will be naturally led to inquire, are you to estimate whether the function of the kidneys is increased, if not by the amount of urine passed ? I answer

by ascertaining its specific gravity, by finding out how much solid matter each fluid ounce contains. This is effected in various ways. For all practical and clinical purposes the specific gravity measure is sufficiently accurate, although so far as mathematical exactitude is concerned, it records, on the average, an error of at least 5 to 7 per cent. and the process is simple enough. Seventy ounces of urine with a specific gravity of 1.010, indicates that 700 grains of solid material are contained in it, and thirty-five ounces, with a specific gravity of 1.020, records the same fact. In both instances the same amount is in reality secreted, although the quantity of urine in the one case, is double that of the other, because the urinometer shows that the specific gravity of the two occupies exactly the reverse proportion. This it is true is but a rough way of ascertaining the result, but it is sufficiently accurate for most purposes. If you desire greater exactitude, tables are prepared in all the works on this subject, which may be readily consulted.

So far then you are to understand this fact, that in estimating the degree to which the kidneys are performing their duty, you cannot assume because a patient passes 40 ounces one day, who the day previously voided only 20, that the function of these organs is increased, unless you ascertain at the same time, that the augmented quantity of fluid holds in solution a proportionate increase of solid matter. And you will understand from the reasons I have just advanced why it is that so many inert substances given in a large amount of fluid, have had erroneously attributed to them diuretic properties.

There is scarcely a medicinal spring in the world that is not so considered, and although, unquestionably many of them do possess these virtues, yet you can easily imagine that one or two pints of any water taken before breakfast upon an empty stomach, whether medicinal or otherwise, if it does not find its exit by the skin, or pass off by the bowels, must filter out through the kidneys; one of their

physiological purposes being, as I told you, to keep the amount of water in the blood in a proper proportion. So also with lager beer, so extensively patronized, and which by many physicians has decided diuretic properties attributed to it, and the innumerable cold infusions of vegetable substances, all of which are administered with the same view ; the fluid in which the barley and hops are infused in the first instance, or the inert vegetable in the other, passes off through the kidneys, with little or no real effect so far as the solid contents are concerned. I say little or no effect, for although the principal result occasioned by the fluids I have mentioned is to increase the quantity of water ; yet the mere transit of a certain amount of water from the blood to the kidneys, and hence to the bladder, necessarily carries with it a small amount of solids ; and in this sense pure water may be considered a diuretic ; yet this increased amount is very trivial, and not at all what it is usually supposed to be. Looking at the fact in this light, we must consider the copious imbibition of all medicated fluids, whether derived from natural springs or vegetable infusions, to a certain extent diuretic. But they are not more so than pure water would be, nor do they exert in this respect any greater degree of remedial influence. What then is the therapeutic advantage to be derived from the copious imbibition of simple cold infusions or of cold water, so far as the kidneys are concerned ? It is this, it helps to remove certain noxious principles from the blood in febrile diseases, in virtue of its diluent properties ; it places the kidneys in a better condition for elimination by diluting the urine and thus preventing irritation of these organs by a too concentrated secretion ; and in all cases of irritation or inflammation of the urinary passages, on the same principle, it obviates in a measure one of the causes which tend to keep up this condition.

But you are not to understand me, gentlemen, as intending to convey to you the idea, that the amount of water secreted by the kidneys, is of little or no importance,



and that the solid elements only are subjects of therapeutic consideration. In my remarks thus far, I desire to impress upon you the fact, that if the skin acts less freely, the kidneys will secrete the more fluid ; and that if a pint or a quart of pure water or an inert effusion is taken, the additional amount of urine secreted, must not be considered a diuretic effect. Both are simple physiological occurrences, and have no further therapeutic value than what I have just stated.

But, on the other hand, there are certain substances, which when taken into the economy, seek their outlet through the kidneys, and in so doing, stimulate these organs into increased activity, the increase being both of water and solids, such for instance as squill, juniper, cantharides and turpentine ; and in their application to disease, the water is the element of most importance. In dropsies for example, we desire the absorption of the effused fluid, and this is to be accomplished either by increasing the secretion from the skin, the kidneys or the alimentary canal. Certain rules, which will guide us in the selection of one or the other of these, I shall detail presently. But when for some particular reason the kidneys are selected, and by the administration of one of these agents, the amount of water is increased, not because the cutaneous transpiration is lessened, or more fluid is taken into the stomach, but because their function—is in reality augmented ; it follows, that as the blood is drained of its fluid, a portion of that constituting the dropsy, must be reabsorbed to restore the equilibrium. It is in dropsy, that diuretics have been principally employed ; and hence it is, that the mistake has arisen, of supposing that an increased quantity of urine always evidences a diuretic effect, and of overlooking the importance of separating the solid and fluid elements from each other in the treatment of all other diseased conditions.

Until within a few years past, no class of remedies were considered so uncertain and so capricious in their action

as diuretics ; and such is even the case, though to a less degree, at the present time. Among those in most common employment, are the salines, mercury and digitalis, oftentimes given indiscriminately, and still oftener combined together in the vague hope that if one failed to operate, the other might succeed. The mode of action of these substances is at this time better understood, and I shall endeavor to explain the principles upon which their operation is founded. And first, of Salines.

At the very commencement of this Course of Lectures, I stated to you, that the absorption of medicines was partly explicable on the principle first pointed out by Dntrochet, of endosmosis and exosmosis ; and in speaking of saline cathartics, I adduced the same explanation in regard to their hydragogue action. Their operation on the kidneys is also referable to a similar law. Let me in a few words describe this phenomenon. Suppose a glass tube, open at both extremities, have a piece of animal membrane, the bladder for example, tied firmly over one end ; suppose also, this tube be filled with syrup, and immersed in a glass of distilled water. In a short time the fluid will rise in the tube, the water having permeated the membrane and diluted the syrup ; this is an example of imbibition or endosmosis. Empty the tube, partly fill it with water, and immerse it in syrup, the fluid will now fall in the tube, exuding through the membrane and diluting the syrup, in the external vessel, by exosmosis. As a general law, so far as living tissue is concerned, it is sufficient to state, that when two different fluids capable of mixing, are separated by an animal membrane, the fluid lowest in specific gravity, will permeate the membrane, to dilute the denser fluid. In dead animal membrane, whilst imbibition goes on, a certain amount of exudation also occurs, though to a much smaller extent, and vice versa ; whether this also occurs in living tissue, that is, whether endosmosis and exosmosis both take place at one time, there are no facts

which will enable us to decide, but the probability is, that they do.

The alimentary canal and the blood-vessels may be considered as separated by such a membrane ; both contain a certain amount of fluid, and if to the first a saline solution be added, its density or specific gravity must determine, whether it shall be absorbed or otherwise. If the saline substances are intended to be absorbed, and ultimately to reach the kidneys, it is necessary that the density of their solutions should be much below 1.028, which is the specific gravity of the serum of the blood ; indeed, experience has shown that the proportion of solids, dissolved in the aqueous vehicles prescribed, should be less than five per cent. Thus a tolerably strong solution of the tartrate or acetate of potass, or of sulphate of magnesia, will altogether escape the absorbents ; indeed, so far from being imbibed by the capillaries, it will actually excite an exudation of water from these vessels in the stomach and intestines, thus becoming diluted by exosmosis, and exciting purgation, while a sensation of thirst is excited, on account of which the patient is compelled to drink, for the purpose of supplying the water removed from the blood by exudation. We can thus understand why half an ounce of acetate or of tartrate of potass will purge, and a scruple of either excite diuresis. This phenomenon clearly explains the rationale of the diuretic or non-diuretic action of salines in most cases : and if we hope to arrive at any certainty in their effects, must always be borne in mind. I say, in most cases, for it to occur invariably, certain conditions are necessary, which do not always exist. Were the coats of the blood vessels and intestinal canal, always in the same condition, the quality of the blood at one uniform standard, and the bowels always empty, there would be no difficulty in regulating exactly a diuretic or cathartic action, and producing always a fixed and definite amount of fluid discharge. But these conditions are not uniform, all three undergo certain variations, and occasionally produce op-



posite results from those we desire to attain. Thus the salt given in such a state of concentration as should provoke a discharge of serum to dilute it, and, as a consequence purgation, may encounter so large a quantity of fluid in the bowels that it becomes of less density than the serum, it therefore, enters the blood, and is passed off by the kidneys. Or again, the coat of the bowels may under certain conditions, become exceedingly irritated by even a dilute saline solution, so that instead of being absorbed, it occasions congestion of the mucous surface, and subsequent serous effusion, with purgation; or on the other hand, a very strong solution may irritate so highly, as to impair the function of the membrane, so that no secretion takes place, and consequently no purgation. It is true also, that some influence is to be attributed to a direct stimulant effect exerted by the saline upon the capillaries of the gastro-intestinal membrane, and we must remember, that if a large amount of a dilute saline mixture be taken into the stomach, such for example as some of the natural spring waters, a certain amount is absorbed into the blood till the fluid is filled to repletion, and the remainder then acts as a purgative by distention merely. These are some of the circumstances that modify the action of these agents, but the general law remains unharmed, and must as I said, be taken into consideration in their administration. But, more than this, the proper employment of these salines, may even be a matter of grave import. If for example, a patient is suffering from active congestion of the kidneys, evidenced by scanty urine, containing blood and serum, and we desire to produce purgation by means of one of the salines, it is of every importance that the solution be sufficiently concentrated. For if very dilute, on the principle I have been discussing, it will most likely enter the blood, and seek an outlet by the kidneys, thereby aggravating the existing disease, and convert perhaps by its irritant operation, simple congestion into active inflammation.

But you will ask, what are the immediate effects of these salines on the composition of the urine, and in what special manner is the function of the kidneys affected? In the first place, in passing out with the blood they carry with them a certain amount of water; and the urine is increased by this water, and by the salines also. But more than this is occasioned. No class of medicines are more powerful as alteratives, producing their effects by hastening the metamorphosis or destruction of tissue, than the alkaline salts. These effete materials are also taken from the blood, and pass out with the rest in the urine. Thus this secretion under the use of alkaline salts, becomes increased both as to its amount of water, and the solids it holds in solution. The first derived from the blood, passing out with the medicine, while the latter is composed of the medicine itself, and the effete elements which is produced in its passage through the system. But I desire you to bear this in mind, the diuretic effect in this case, is almost altogether secondary. The urinary elements are not increased, because the kidneys are stimulated to increased action; but, inasmuch as one of their functions is to remove from the blood, useless and worn out material, they merely in accordance with this law, abstract the additional amount that the operation of the alkaline salt has occasioned in its transit through the body. Their diuretic effect then is indirect, and not primary, and I am particular in making this distinction, because many of the so called diuretics are equally secondary in their operation. Increased muscular exertion produces increased waste, and an increased amount of material is as a consequence presented to the kidneys for removal; and if we are to consider all substances as diuretics which provide additional material for the kidneys to eliminate, and, consequently produce an increase in the urinary secretion, most alteratives must be so classified, and exercise must be included under the same head.

Among the salines, the most important, in all probability, is the bi-carbonate of potash. Allow me to explain some of the more important points of its operation.

You have learned that when the acetate of potash is administered internally, it does not enter the circulation as an acetate, but becomes changed and is absorbed as a carbonate, so that in reality so far as the ultimate effects of the two salts are concerned, it is a matter of little importance whether the acetate or the carbonate be administered. But, upon the stomach, the action is different, the acetate produces more irritation than the other, and the bi-carbonate is consequently the preferable agent, whenever it is thought advisable to administer the remedy in large quantities, or for any length of time. And herein lies the efficacy of this salt in rheumatism ; not so much for the diuretic action it occasions, as for the waste and alteration it produces on the tissues at large, and, among the rest, those involved in the rheumatic disease.

You are aware that the fibrine of the blood, the coagulable element, undergoes various changes in disease, both as regards quantity and quality. So far as its quantity is concerned, a vast increase is noted in inflammatory and certain other morbid conditions, among them rheumatism, in which the absolute amount becomes tripled and even quadrupled above its usual healthy standard. I must tell you also that there is a difference of opinion among pathologists as to whether this increase of fibrine is indicative of a greater or less degree of vitality in the blood ; that is, whether an augmentation of fibrine from three parts in the thousand its normal amount, to twelve parts, is due to an increase of formative power, or that it rather evidences an accumulation of effete material in the blood. This question, at the present time, it is hard to decide, but as far as I am able to judge, I hold that this increase is rather the result of retrograde than of formative changes. There are others, however, who maintain a different view, and think the large amount of this fibrine in the blood, which as I just said, is one of the characteristics of acute rheumatism, is the cause of many of the phenomena of the disease ; and as the alkaline salts have the property to a

very great degree, when given in large and continuous doses of destroying the plasticity of the blood, and diminishing the quantity of fibrin it contains, would assume that the benefit derived from these remedies is due to this fact. This may be so, but whether correct or otherwise, I am satisfied that all the good effect exerted is not in this mode. Not only do the alkalies lessen the fibrin, but like mercury they increase the waste of tissue, as well as of the elements of the blood itself—and when disease is present, the morbid principles that this fluid contains. It is in this way principally that it proves beneficial in rheumatism, and is preferable as you have seen, to both the carbonate and acetate as it is less irritating; and to mercury, because it is more manageable. But in the treatment of this disease it is necessary that it should be administered in large doses, at least 30 to 60 grains every two or three hours if the stomach will bear it. It is of course inapplicable to cases of rheumatism occurring in debilitated and ill nourished individuals; and is, therefore, not a specific for it, as many of its advocates would seem to imply. It will be noted, also, that under its use, when it acts favorably, the quantity of urine becomes increased, and there is also an additional amount of solid material contained in it. It is, therefore, in one sense a diuretic, but I beg you to recollect what I have stated more than once, that this increase is not so much owing to stimulation and increased function on the part of the kidneys, as because the remedy has produced additional waste, and has, therefore, provided more material for these organs to excrete.

In this same connection I would allude to the popular idea that asparagus and water melons are diuretic, neither of which has any effect beyond in the first instance impregnating the urine with its odoriferous principle, and in the other of passing off the large quantity of water, which is contained in the bland fluid of the fruit. Many other substances besides asparagus afford to the urine a peculiar odor, among them turpentine, but this latter you have

seen does in reality increase the function of the kidneys, and promote an increased secretion.

It has been taught also that a diuretic action is sometimes occasioned by sympathy, and that certain substances act on these eliminating organs through the medium of the nervous centres. It has been stated that a medicine admitted into the stomach, may produce a certain impression on the mucous coat, which will be transmitted to the sympathetic or spinal centres, and from them to the kidneys, which will be excited to an increased performance of their function. But this assumption is purely gratuitous, and there is no single fact which will support it. The application of cold to the skin it is alleged, acts in this way. For example, it is said more urine is passed in winter than in summer, and the exposure of the body to the cold air, or walking barefoot over a cold floor, will often in a short time be followed by a flow of urine. But why need we suppose that nervous sympathy occasions this result, when it can be explained more satisfactorily and more rationally by the kidneys passing off the water which the skin is suddenly prevented from doing. The perspiration and pulmonary exhalation, through the vaporization of the liquid eliminated from the blood vessels of the skin and bronchial membrane, are a never ceasing cause of the reduction of temperature. But this is not now needed owing to the direct application of cold; which at the same time has a tendency to check this exhalation. Consequent therefore upon the suspension of these two functions, there is an accumulation of fluid in the circulation; and as the function of the kidneys is in part to regulate the amount of water in the blood, they abstract it, and hence there is observed an increased discharge of urine. Such at least is the view I hold of the rationale of the operation of cold in augmenting the urinary secretion.

In many works on therapeutics, you will find it stated that strychnia and assafoetida increase the function of the kidneys. But here again the effect is secondary and indirect only.



For the necessary performance of any of the vital functions, one of the first requisites is that it should be supplied with a proper amount of nervous energy. A want of this oftentimes is the sole cause of imperfect secretion on the part of the stomach, the liver and the intestinal canal; and so also do the kidneys sometimes fail in their function, and as a consequence there is a retention of morbid materials in the blood. Strychnia by stimulating the spinal cord into increased activity, stimulates equally the nerves which proceed from it, and among the rest those supplied to the kidneys. Hence these organs again resume their normal action, and there is discharged not only the daily and healthy waste, but that, that has accumulated in consequence of their inactivity. A similar phenomena is observed in hysteria. Without entering into an explanation of the pathology of this affection, it is sufficient to know that during the paroxysm and preceding it there is an irregular distribution of nervous energy to the various organs. Hence there is impaired function, and the kidneys as well as the other secreting organs fail in the performance of their duty. From this there results accumulated material in the blood, which is discharged as the paroxysm passes off, and equalization of nervous distribution takes place, and I have no doubt that a portion of the good effects observed from assafœtida in these cases, is the influence that its stimulant operation upon the nervous system exercises, in regulating and affording a due supply to the kidneys, and thus enabling them to remove those retained elements from the circulation which tended to keep up the hysteric attack.

After the use of both these medicinal substances, then diuresis takes place under certain circumstances. But they cannot be called diuretics, inasmuch as the liver is affected in a similar way; and both organs are brought into increased activity, not from the direct effect of the medicines, but in consequence of their operation on the nervous system generally.

The condition of the blood vessels is also an important

ingredients. Here all stimulating diuretics are not only valueless but absolutely injurious, while the guarded employment of the infusion of digitalis by quieting the irritability of the heart, and calming the irregular circulation, diminishes the congested state of the vascular system, and acts indirectly as a most efficient diuretic.

I have now gentlemen, at some length entered into an explanation as to the mode in which an indirect diuretic influence is effected, little remains to be said of those that operate directly. Certain medicinal agents contain some peculiar principle, generally a volatile oil; and this principle after absorption into the blood, seeks an exit by the kidneys. Brought into direct contact with these organs, it produces irritation and a moderately increased afflux of blood, and in accordance with the physiological law that the function of a healthy secreting organ becomes increased in proportion to the increased supply of blood, provided this increase is not sufficient to over-whelm it, a large amount of urine is abstracted from the blood. The kidneys under these circumstances may be said to have responded to the direct influence of the medicine.

The principal agents of this class are squill, juniper, turpentine, and cantharides. And in reference to their operation I have stated that within a few years past, Dr. Hammon of the Army, has experimented with several of these diuretics, with a view of determining their physiological effects. He shows that juniper increases the amount of fluid discharged by the kidneys nearly one-third, and squill one-half. Both, however, diminish the waste of solid material, and their efficacy is confined to dropsical affections alone. Asparagus officinalis on the other hand, increases the amount of secretion, as well as of fluid, and is therefore entitled to rank as a diuretic, among which class of remedies, you will readily perceive I have placed it.

Let us now consider the therapeutic indications afforded by this class of remedies. The obvious effect of diuretics as you have seen, is to diminish the quantity of liquids and solids in the circulation. It is true that the portion

of the blood evacuated by them, is chiefly the water; but some of the saline matters and also more or less of the organic constituents escape; so that these medicines may be considered depletory. Indeed they sometimes operate so profusely, that they produce weakness approaching even to prostration.

Another important effect consequent upon the diminution of the watery portion of the blood, is the promotion of absorption. It has been established by experiment, that the blood vessels when their contents are materially diminished, take up water with avidity whenever they can find it, to supply the loss. Thirst also results from the diuretic action, with the obvious purpose of securing a supply of liquid for absorption. But it is not taken up solely from surfaces with external communication. The liquid in the tissues and cavities is also absorbed, and hence then, it is this class of medicines in dropsy.

A third effect is to purify the blood of excrementitious or foreign matter, which may by its retention, be a source of injury and disease.

A fourth, which is produced by the stimulus from diuretics alone, is to irritate the lining membrane of the pelvis and calices of the kidneys the urinary passages and the bladder, and thus not unfrequently either to alter the diseased surface, or to excite the parts to greater activity.

And lastly, by diluting the urine free of sediment when an increased amount of water is discharged, the irritation is rendered less irritant to the parts with whom it is brought into contact.

In accordance with these principles therefore, we find these agents applicable to various diseased conditions.

In the first place I would remark, that in all acute blood diseases, or those in which certain changes have resulted in this fluid, consequent upon peculiar diseased conditions, there results an accumulation of the material, which in part explains the phenomena of the affection under which the patient labors. It is of vast importance that this should be eliminated, and as a general rule a certain amount is



always passed off by the kidneys. And I know of no rule more important in the management of this class of diseases, than that constant attention should be paid to the mode in which these organs are performing their function. Through these as I said, the greater part of the results derived from the diseased processes is eliminated, and they should be aided as far as possible by the various modes I have suggested.

Their principal employment however, is in dropsical effusions. But, before applying diuretics to this condition, you must bear in mind, that dropsy is but a symptom of congested blood vessels; that the cause of this congestion may be permanent and irremediable, or transient only, that in treating it you are but treating the results of the disease, and not the disease itself. Nevertheless, often-

this is all that can be effected, or it may be that you address remedies to the cause, and to the effect at the same time. Thus, from a congested liver, there is en-

gorgement of the portal vein, and subsequently, effusion into the peritoneal cavity. Hydragogue cathartics will, in some cases, be of great service, by producing copious serous discharges, relieving the effusion; there the remedy is addressed to the effect only. But, suppose you combine together blue pill and squill, the first tends to relieve the engorged liver, or the congestion, while the squill stimulates the kidney into increased action, and thus removes the effect. Let me endeavor, in a few words, to define the relation of diuretics to dropsy.

First of all, whether the effusion be occasioned by, or even if it be coincident with an altered kidney, whether the change consists in alteration or degeneration of structure on the one hand, or simple congestion on the other, whether Bright's disease, scarlatina, or congestion from the effects of cold, all direct diuretics are decidedly inadmissible. In both, the urine will contain albumen and perhaps blood, there will be a deficient amount of the ordinary urinary elements, and whose structural alteration exists, the microscope will evidence the presence of certain of these structural elements thrown off with the urine. Now this condition of the urinary

secretion evidences two facts, first, that the kidneys are not performing their function in a proper manner, and secondly, that they are prevented from doing it by the existence of certain physiological changes. They are already congested as the albuminous urine shows, and agents whose mode of operation is to stimulate them to increased action, would but add to the trouble already existing, instead of removing it. Here such means are to be employed as the nature of the case may demand. Bleeding and cupping over the loins, if the condition be simply due to active congestion of the kidneys; blue pill if the liver be the source of the evil, and digitalis and reserpin if obstruction in the heart's action occasion it. These then are the measures to be adopted, and are in a peculiar sense indirect diuretics, but such medicines as squill, cantharides, nitrate of potassa, &c., are entirely out of place. My limits forbid that I should enter more largely into the subject of dropsy, but as a practical application of what you have said, I would advise you in all cases, before resorting to direct and irritating diuretic medicines, to examine the composition of the urine as well as its quantity. If it contains albumen, and more particularly if it is of low specific gravity, they must be avoided, for if a cathartic effect at all is occasioned by their administration, it doubtless will be an injurious one.

Certain diuretic remedies are of vast service in inflammatory diseases of the kidneys and urinary passages. They operate by diluting the urine and rendering it less irritant to the inflamed membrane. For in these complaints this secretion is often loaded to saturation and even beyond it with the saline and other ingredients, in consequence of the small proportion of the liquid eliminated. By increasing this, the salts which might otherwise be deposited, are held in solution, and those dissolved are rendered less irritant by the dilution.

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GENERAL REMARKS

DIURETIC REMEDIES,

DELIVERED AT THE

University of Maryland,

FEBRUARY 16, 1860.

By CHARLES FRICK, M. D.,

PROFESSOR OF MATERIA MEDICA AND THERAPEUTICS.

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PUBLISHED BY THE CLASS.

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PHILADELPHIA :

PRINTED BY JOSEPH W. WOODS

NO. 204 N. SECOND STREET.













consideration in reference to diuretic agents. As the kidneys derive their secretion altogether from the blood, a certain amount of vascularity is of course the normal condition. And all medicines which act directly in increasing the quantity of urine, do so by stimulating these organs, and consequently producing an increased access of blood to them. But this access must be bounded within well defined limits, for if it pass beyond a certain point, the increased vascularity impedes and prevents secretion, rather than assists it, and this brings us to the recognition of two important points: first, that blood letting may promote diuresis, and secondly, that any agent whose immediate effect is to stimulate the kidneys into increased action, may if injudiciously employed have exactly the opposite effect.

Let me illustrate these assertions by examples. Turpentine or cantharides, when given in small quantities, become absorbed, enter the blood, and pass out by the kidneys. In their transit, the volatile oil of the one, and the irritant principle of the other, stimulate the urinary surfaces, from the pelvis of the kidneys to the mucous membrane of the bladder, provoking an increased secretion from the various tissues and organs it is brought into contact with. Hence there is an augmented secretion of urine, and the remedies become, under certain circumstances, valuable medicinal agents. But suppose the dose of the cantharides or of turpentine be very much increased, there results then still greater vascularity of the kidneys, so much so that the function is in a measure arrested, and the medicine, far from being useful, has been productive of absolute injury.

Again, it not unfrequently happens, either from structural disease in the kidneys themselves, or elsewhere, that there is an undue accumulation of blood in their structure, totally unfitting them for healthy secretion, and manifested by the appearance of bloody or serous urine. Here, also, all stimulants must prove injurious. But blood-letting, by directly abstracting blood, hydragogue cathartics, by indirectly accomplishing the same purpose, or tartrate of an-

timony, by lowering the force of the circulation, all occasion ultimately the same effect. The congested kidneys, relieved from their engorged condition, resume their proper function ; and in this way blood-letting, tartrate of antimony, and hydragogue cathartics, might be considered indirect diuretics ; but you must recollect that the liver or the lungs might be relieved in the same way ; and, therefore, the term diuretic, as indicative of a special influence, is not applicable to them.

You may be called, for example, to a case of this character. An individual, advanced in life, has been exposed to cold, and shortly afterwards has a chill, followed by vomiting. The vomiting persists for several days in spite of the usual remedial means, and is found to consist of alkaline instead of acid matters ; there is no evidence of any inflammatory lesion of the stomach, and there is either complete suppression of urine, or the discharge is very small, highly colored, and copiously intermixed with blood. Now what is the explanation of the phenomena thus presented ? The patient, from exposure to cold, has experienced a general congestion of the abdominal organs, more particularly the kidneys. Their secretion being thus suddenly arrested, and retained in the blood, a portion of it, the urea for example, endeavors to seek an outlet through the mucous coat of the stomach, thus accounting for the vomiting, and the alkaline character of the matters thrown off, for it has undergone decomposition and become changed into carbonic acid and ammonia. Such a case as this must necessarily end fatally unless relief is obtained either spontaneously or by judicious interference. And the latter should manifestly consist in the abstraction of blood from the loins, or the anus, or both, and such revulsive measures as are calculated to restore the suffering organs to their healthy condition. All treatment to the stomach alone would be but a waste of means, and a loss of valuable time.

I have adduced the preceding illustration for two reasons. Partly to show the relation of blood-letting in restoring the function of the kidneys ; and partly, also, to demon-

strate the important part these organs play in many diseased conditions, and the necessity of making inquiry in all obscure affections, as to their proper performance.

Allow me, in continuing this subject, to bring before you a few more instances of the value of correct pathological ideas, before you can hope to have a proper understanding of the rationale of the mode of operation of diuretic medicines.

All remedial substances intended to influence the kidneys must first enter the blood and be brought into direct contact with them. And in diseases in which an extremely irritable condition of the gastro-intestinal membrane exists, diuresis is often excited with great difficulty; and it is scarcely possible to cause any remedy to reach the urine by direct absorption. Where there is any considerable diarrhea, and copious liquid stools are excreted from the bowels, the urine is always scanty and high colored, a condition necessarily arising from its concentration; water freely exuding through the intestines from the blood, and hence, but little is left to escape by the kidneys. An extreme instance of this state of things is found in epidemic cholera; here water is so rapidly pumped off through the intestinal exhalents, that the blood is left absolutely viscid and thick. Hence the nitrogenised elements which it is the duty of the kidneys to excrete, cannot be removed in consequence of the escape of the water by the intestines which would normally have washed them from the circulation; and the patient oftentimes dies from a retention of the poison in his circulation, which the kidneys are unable to remove.

I said at the commencement of this lecture that salines, mercury, and digitalis, were all classed as diuretic medicines. I have discussed the mode in which the first of these operates, let me now consider mercury and digitalis.

Whenever a sluggish state of the portal circulation exists, either because the liver is congested, or has become cirrhotic an obstacle is presented to the transit of the blood from the intestinal capillaries to the vena porta.

Less blood passes through the liver and the ascending cava to the heart, and consequently less to the renal arteries. A smaller supply must therefore reach the kidneys, and the urine will become diminished in quantity. In such cases, moreover, dropsy is very apt to occur, which is to be regarded as a sort of vicarious effort to relieve the congested state of the veins, by allowing the watery elements of the blood to filter through the walls of the smaller vessels. We desire in such a case, to restore the function of the kidneys, partly with a view of removing the dropsy, and partly for other reasons. It is useless here to attempt to stimulate these organs into action with cantharides, copaiba and squills, for this will result only in setting up congestion, or perhaps inflammation, without increasing the secretion of urine, simply because the fluid elements are prevented from reaching the kidneys; and if the alteration of the liver be structural and irremediable, there is no other course to be pursued but to endeavor to remove the dropsical effusion by remedies which, like elaterium and scammony, exert a hydragogue influence on the intestines. But the condition of the liver may be remediable, and experience has shown that no substance effects so promptly an increased discharge of urine in the dropsy connected with congested or even contracted liver as blue pill. It does this by stimulating this organ into action, more bile is secreted, the portal congestion is relieved, the obstructed circulation through the heart and to the kidneys is again established, and diuresis takes place.

The last of the indirect diuretics that I shall speak of is digitalis. I have told you in a previous lecture, that the physiological action of this drug, was to diminish the force and frequency of the heart's action. When the mitral orifice of this organ has become contracted by disease, or it has undergone dilatation, and there is a loss of relation between its cavities and their orifices, general congestion of the capillary vessels ensues and dropsy results, in the kidneys as elsewhere, evidenced in the first, by the escape of serum containing albumen with the ordinary urinary

ingredients. Here all stimulating diuretics are not only valueless but absolutely injurious, while the guarded employment of the infusion of digitalis by quieting the irritability of the heart, and calming the irregular circulation, diminishes the congested state of the vascular system, and acts indirectly as a most efficient diuretic.

I Have now gentlemen, at some length entered into an explanation as to the mode in which an indirect diuretic influence is effected, little remains to be said of those that operate directly. Certain medicinal agents contain some peculiar principle, generally a volatile oil; and this principle after absorption into the blood, seeks an exit by the kidneys. Brought into direct contact with these organs, it occasions irritation and a moderately increased afflux of blood, and in accordance with the physiological law that the function of a healthy secreting organ becomes augmented in proportion to the increased supply of blood sent to it, provided this increase is not sufficient to overpower it, a large amount of urine is abstracted from the blood, and the kidneys under these circumstances may be said to have responded to the direct influence of the medicine.

The principal agents of this class are squill, juniper, turpentine and cantharides. And in reference to their operation, I would state that within a few years past, Dr. Hammond of the army, has experimented with several of these diuretic substances, with a view of determining their physiological action. He shows that juniper increases the amount of fluid discharged by the kidneys nearly one-third, and squill one-sixth. Both, however, diminish the waste of solid material, so that their efficacy is confined to dropsical affections alone. Colchicum on the other hand, increases the amount of solids as well as of fluid, and is therefore entitled to rank as an alterative, among which class of remedies, you will remember I have placed it.

Let us now consider the therapeutic indications afforded by this class of remedies. The obvious effect of diuretics as you have seen, is to diminish the quantity of liquids and solids in the circulation. It is true that the portion



of the blood evacuated by them, is chiefly the water ; but some of the saline matters and also more or less of the organic constituents escape ; so that these medicines may be considered depletory. Indeed they sometimes operate so profusely, that they produce weakness approaching even to prostration.

Another important effect consequent upon the diminution of the watery portion of the blood, is the promotion of absorption. It has been established by experiment, that the blood vessels when their contents are materially diminished, take up water with avidity whenever they can find it, to supply the loss. Thirst also results from the diuretic action, with the obvious purpose of securing a supply of liquid for absorption. But it is not taken up solely from the surfaces with external communication. The liquid in the tissues and cavities is also absorbed, and hence the use of this class of medicines in dropsy.

A third effect is to purify the blood of excrementitious or foreign matter, which may by its retention, be a source of injury and disease.

A fourth, which is produced by the stimulating diuretics alone, is to irritate the lining membrane of the pelvis and calices of the kidneys the urinary passages and the bladder, and thus not unfrequently either to alter the diseased surface, or to excite the parts when debilitated or paralyzed, to greater activity.

And lastly, by diluting the urine freely, as when an increased amount of water is discharged, the secretion is rendered less irritant to the parts with which it is brought into contact.

In accordance with these principles therefore, we find these agents applicable to various diseased conditions.

In the first place I would remark, that in all acute blood diseases, or those in which certain changes have resulted in this fluid, consequent upon peculiar diseased conditions, there results an accumulation of effete material, which in part explains the phenomena of the affection under which the patient labors. It is of vast importance that this should be eliminated, and as a general rule a certain amount is

always passed off by the kidneys. And I know of no rule more important in the management of this class of diseases, than that constant attention should be paid to the mode in which these organs are performing their function. Through these as I said, the greater part of the results derived from the diseased processes is eliminated, and they should be aided as far as possible by the various modes I have suggested.

Their principal employment however, is in dropsical effusions. But, before applying diuretics to this condition, you must bear in mind, that dropsy is but a symptom of congested blood vessels; that the cause of this congestion may be permanent and irremediable, or transient only, and that in treating it you are but treating the results of disease, and not the disease itself. Nevertheless, oftentimes, this is all that can be effected, or it may be that you can address remedies to the cause, and to the effect at the same time. Thus, from a congested liver, there is engorgement of the portal vein, and subsequently, effusion into the peritoneal cavity. Hydragogue cathartics will, in all probability, by producing copious serous discharges, relieve the effusion; there the remedy is addressed to the effect alone; but, suppose you combine together blue pill and squill; the first tends to relieve the engorged liver, or the cause, while the squill stimulates the kidney into increased action, and thus removes the effect. Let me endeavor, in a few words, to define the relation of diuretics to dropsy.

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neys must either be in solution when administered, or capable of being dissolved in the fluids contained in the stomach or small intestines, after being swallowed. They should be given when the stomach is empty, for as they must reach the kidneys through the medium of the blood, absorption is more likely to occur just before a meal than after taking food. If the medicine be a saline, it should be so diluted as to have a specific gravity decidedly below that of the serum of the blood; that is, they should not contain more than five per cent. of solid matters. If not given in this dilute form, a very free use of water, pure, or containing mucilage, should follow them.

In the second place, during their use, the state of the skin should be attended to, and anything like perspiration avoided; nor should they, as a general rule, be given at the same time with cathartics or diaphoretics. The patient should be kept cool, or at least should not be allowed to become heated, as by too much bed-covering at night, during their administration.

In the third place, it is as well that the drinks taken during the use of diuretics should be cold.

And fourthly, care must be taken that they do not act on the bowels, for this will completely counteract their operation on the urinary organs. For this reason, when they have any tendency to operate as cathartics they should be given in small and repeated doses instead of large ones. Combining a small quantity of morphia with the diuretic will often check its purgative tendency without interfering with its action on the kidneys, and may therefore often be added with advantage.

And now gentlemen in conclusion, I think I have said enough to show you that diuretics need not be altogether uncertain agents, if they are used with due discrimination, and with a proper knowledge of pathological processes;—and that as direct or indirect remedies they are among the most important in the whole materia medica. Reflect for one moment what office in the economy the kidneys fulfill. Not only are they a counterbalance for the perspiratory function, so that when one acts the more, the other secretes

the less, more urine in winter than summer, and more perspiration in summer than winter;—but their duty also is to prevent too great fullness of the blood-vessels. These latter must take up the fluid presented to them, but it is the office of the kidneys to abstract any excess from them, and thus prevent them from being overloaded. But they do more than this: all the materials formed as a result of the disintegration of the body, must find an outlet: the most important make their exit by the kidneys. Many substances taken into the economy, either as poison, as medicine, or as food, and which can subserve none of the purposes of the economy either for nutrition or respiration, must be thrown out, and the kidneys again are the principal organs to which this purpose is delegated.

With all these manifold offices then, how important becomes a proper understanding of their function, and the mode in which they are performing this function, in the diagnosis and prognosis of disease. Diuretics are the agents which cause this function to be increased; some augmenting merely the watery portion of the urine, while others seem to stimulate these organs in the performance of their great office of depurating the blood, and increase in a very remarkable manner the quantity of solid matters eliminated. With these effects what valuable assistance are they capable of affording to the treatment of disease. But I must tell you that they are mutually dependent, no exact rules can be laid down for the administration of diuretics, and you can only be guided by a correct knowledge of the healthy function of these organs, and the intimate relation they bear to most diseased conditions.

I have attempted, gentlemen, in the present lecture, to give you a brief outline of the rationale of action of this class of remedial agents. It is a subject that enlarges as I go on, and if my limits would permit, might readily embrace several more lectures, and will at all times be found to repay your careful study. I have taught you to day, views that are in many respects not at all in accordance with generally received opinions, but which from some study and experience, and to the best of my knowledge I believe to be true.





